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(54) [Title of the Invention] IMAGE READER

(57) [Abstract] (Modified)

[Object] To perform excellent document reading without being affected by the density variations or the like in a white board or the like serving as reference used for adjusting the level of an image-read signal.

[Construction] A light source 104 configured to expose a document image to light, document-platen glass on which a document is placed, a line CCD 111 configured to read the document image that is exposed to light by the light source 104 and that is placed on the document-platen glass 102, an analog-signal-processing circuit 112 configured to adjust the level of a signal output from the line CCD 111, a bar-coded white board 103 provided with a bar code representing the value of chromaticity that had been measured, and a CPU 116 configured to control the light amount of the light source 104 and the amount of level adjustment performed by the analog-signal-processing circuit 112 based on an output signal obtained by reading the bar-coded white board 103 through the line CCD 111 and the chromaticity value represented by the bar code are provided.

[Claims]

[Claim 1] An image reader comprising a light source configured to expose a document image to light, document-platen glass on which a document is placed, read means configured to read the document image that is exposed to light by the light source and that is provided on the document-platen glass, adjustment means configured to adjust the level of a signal output from the read means, a reference white board provided with a bar code representing the value of chromaticity that had been measured, and control means configured to control the light amount of the light source and the amount of level adjustment performed by the adjustment means based on an output signal obtained by reading the reference white board through the read means and the chromaticity value represented by the bar code.

[Claim 2] The image reader according to Claim 1, wherein the reference white board is separated from the document-platen glass.

[Claim 3] The image reader according to Claim 1, further comprising setting means configured to set the type of the document-platen glass, wherein the control means changes the amount of level adjustment performed by the adjustment means according to the set type.

[Claim 4] The image reader according to Claim 3, wherein the control means changes the amount of level adjustment performed by the adjustment means according to whether or not a feed mechanism configured to automatically feed the document onto the document-platen glass is used and the type of the document-platen glass, where the type is set by the setting means.

[Detailed Description of the Invention]

[0001]

[Industrial Applicable Field] The present invention relates to an image reader using a line sensor and particularly relates to an image reader configured to automatically adjust a lamp-lighting voltage and a circuit gain from a CCD to an A/D converter.

[0002]

[Description of the Related Art] In an image reader that is used for a copier, a facsimile, and so forth, and that is configured to obtain image data by A/D-converting an output of a

CCD, the level of an A/D-converted signal is determined by the amount of light generated by a power source and a circuit gain from the CCD to an A/D converter. Therefore, the output level of the image reader is adjusted by the light amount (a lamp-lighting voltage) and the circuit gain.

[0003] In the past, the output-level adjustment was performed by using a reference white board (uniform density), reference white paper on a document platen, and so forth. Namely, the lamp-lighting voltage and the circuit gain are adjusted so that data read from the above-described reference white board and/or the reference white paper by the CCD has a predetermined value.

[0004]

[Problems to be Solved by the Invention] In that case, however, there are variations in the density (and/or a colorimetric value) of the white board and the reference white paper. Therefore, the adjustment state changes according to the status of the reference white board and/or the reference white paper used for the adjustment. Subsequently, the signal level of the image-read data is changed.

[0005] Further, limitations are placed on using a mechanism configured to automatically feed a document to be read onto document-platen glass. For example, the position where a standard white board serving as the reference of the output-level adjustment is provided is limited, and the material of the document-platen glass should be different from that of ordinary document-platen glass. In the light of the above-described configuration, the use of the same adjustment method as that of a reader using no automatic-document-feed mechanism does not allow performing adjustment appropriately.

[0006]

[Means for Solving the Problems] Accordingly, the present invention provides an image reader that can perform excellent document-image reading without being affected by, for example, variations in the density of a white board and/or white paper serving as the reference of adjustment of the image-read-signal level. More specifically, the present invention provides an image reader including a light source configured to expose a document image to light, document-platen glass on which a document is placed, read means configured to read the document image that is exposed to light by the light source

and that is provided on the document-platen glass, adjustment means configured to adjust the level of a signal output from the read means, a reference white board provided with a bar code representing the value of chromaticity that had been measured, and control means configured to control the light amount of the light source and the amount of level adjustment performed by the adjustment means based on an output signal obtained by reading the reference white board through the read means and the chromaticity value represented by the bar code. Further, the present invention provides the image reader, wherein the reference white board is separated from the document-platen glass. Further, the present invention provides the image reader further including setting means configured to set the type of the document-platen glass, wherein the control means changes the amount of level adjustment performed by the adjustment means according to the set type. Further, the present invention provides the image reader, wherein the control means changes the amount of level adjustment performed by the adjustment means according to whether or not a feed mechanism configured to automatically feed the document onto the document-platen glass is used and the type of the document-platen glass, where the type is set by the setting means.

[0007]

[Embodiments] Fig. 1 shows the configuration of an image reader according to an embodiment of the present invention.

[0008] In Fig. 1, reference numeral 101 denotes a document, reference numeral 102 denotes document-platen glass, reference numeral 103 denotes a bar-coded white board (described in detail later), reference numeral 104 denotes a light source (lamp) configured to expose the document 101 on the bar-coded white board 103 and the document-platen glass 102 to light, reference numerals 105 and 106 denote reflection shades, reference numerals 107 to 109 denote reflection mirrors that lead light reflected from the white board 103 and/or the document 101, reference numeral 101 denotes a lens, reference numeral 111 denotes a line CCD including a filter configured to separate colors including red (R), green (G), and blue (B), reference numerals 117, 217, and 317 denote sample-hold circuits configured to separate analog signals R, G, and B transmitted from the line CCD 111 color by color, reference numerals 112, 212, and 312 denote

analog-signal-processing circuits (voltage-controlled amplifiers) configured to process the analog signals R, G, and B, respectively, reference numerals 113, 213, and 313 denote A/D converters configured to convert the analog signals R, G, and B into digital signals, reference numerals 114, 214, and 314 denote shading-correction circuits configured to correct a nonuniform light amount of the light source and/or a nonuniform output of the line CCD 111 due to variations in the sensitivity or the like of the line CCD, reference numerals 115, 215, and 315 denote shading-correction-data memories storing shading-correction parameters for the shading-correction circuits 114, 214, and 314, and reference numeral 116 denotes a CPU.

[0009] Further, the CPU 116 is configured to control the circuit gain of each of the signal-processing circuits 112, 212, and 312, and the lighting voltage of the light source 104, and set the shading-correction parameters to the shading-correction-data memories 115, 215, and 315. Further, the CPU 116 reads data stored in the shading-correction-data memories 115, 215, and 315, and performs calculation for the data. Further, the CPU 116 is connected to an operation-display unit designated by reference numeral 140.

[0010] Fig. 2 shows the configuration of each of the bar-coded white board 103 and the document-platen glass 102. The bar-coded white board 103 includes a white board (white-painted aluminum board) 302 with a bar-code label 303 placed thereon. The bar-coded white board 103 itself is placed on the document-platen glass 102.

[0011] In Fig. 1, the reflection mirrors 107 to 109 are reciprocated by a drive mechanism that is not shown, so that light reflected from the document 101 placed on the bar-coded white board 103 and the document-platen glass 102 is led to the line CCD 111. The CCD 111 photoelectrically converts the light made incident thereon and externally transmits the converted light, as an analog signal.

[0012] Fig. 3 shows the bar-coded white board 103 seen from underneath.

[0013] In Fig. 3, a part bordered with a broken line 201 corresponds to reference-white part of the above-described white board (white-painted aluminum board) 302 and has the uniform density (or the colorimetric value). Further, a part bordered with a broken line 202 corresponds to a part on which the above-described bar-code label 303 is placed (hereinafter referred to as a bar-code part).

[0014] The values of chromaticity coordinates X, Y, and Z that are obtained by measuring the color of the reference white part 201 of the white board, for example, is encoded and recorded on the bar-code part 202. The stored values of chromaticity coordinates X, Y, and Z are corrected into values R, G, and B by performing 3-by 3-matrix calculation, for example (e.g., Equation (1)).

[0015]

[Expression 1]

$$\begin{pmatrix} W_R \\ W_G \\ W_B \end{pmatrix} = \frac{255}{83}\begin{pmatrix} 1.8795 & -0.5787 & -0.1905 \\ -0.6378 & 1.4887 & -0.1079 \\ -0.1197 & 0.2021 & 0.8372 \end{pmatrix}\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} \quad \cdots \text{Equation (1)}$$

[0016] Although any encoding method can be used, an encoding method relating to the bar code shown in Fig. 3 will be described.

[0017] The bar-code part 202 stores the bar code and a code value (alphanumeric characters and "*") used by a person for directly reading the details on the bar code. The format of the code value includes the values C_R, C_G, and C_B of W_R, W_G, and W_B, parity term H, and so forth, as shown in Fig. 4. The bar code is generated by encoding the above-described alphanumeric characters and "*" into black-and-white binary columns.

[0018] The bar-code values C_R, C_G, and C_B are determined by double figures of base thirty-six numbers shown in Table 2 and converted into W_R, W_G, and W_B according to Equation (2).

[0019]

Each of values W_R, W_G, and W_B = 192 + (bar-code data)/16 ··· Equation (2)

[0020] The parity denotes, for example, even-number parity or odd-number parity of bits, where each of the bits corresponds to each digit.

[0021] Fig. 5 is a flowchart illustrating procedures performed by the CPU 116, so as to adjust the lamp-lighting voltage and the circuit gain. The procedures will be described with reference to Fig. 5.

[0022] STEP 1 (Bar-code reading)

The lamp-lighting voltage and the circuit gain are set to initial values, or the previous

adjustment values, and data on the bar-code part 202 of the bar-coded white board 103 is read by the line CCD 111. The above-described data is A/D converted, and temporarily stored in the shading-correction-data memory 115. The CPU 116 reads the contents of the shading-correction-data memory 115, decodes the details on the bar code, and acquires the white-board data W_R, W_G, and W_B recorded on the bar code.

[0023] STEP 2 (Adjustment of Lamp-lighting voltage)

The circuit gain from the line CCD 111 to the A/D converter 113 is set to the initial value and data on the reference white part 201 of the bar-coded white board 103 is read. Then, A/D-converted digital data items R, G, and B are temporarily stored on the shading-correction-data memories 115, 215, and 315. Then, the CPU 116 reads the contents of the shading-correction-data memories 115, 215, and 315, and calculates the maximum-output value Q of each channel. Then, when the expression $Q < K \cdot W_{RGB}$ (where K denotes a constant) holds for the maximum values Q of any one of the channels, the CPU 116 performs control so that the lamp-lighting voltage is increased. When the expression $Q < K \cdot W_{RGB}$ (where K denotes the constant) holds for the maximum values Q of all of the channels, the CPU 116 performs control so that the lamp-lighting voltage is decreased. The CPU 116 adjusts the lamp-lighting voltage by repetitively performing the above-described control so that the maximum value Q becomes substantially equal to $K \cdot W_{RGB}$ (the lamp-lighting voltage is determined to be L_V). (Here, W_{RGB} indicates any one of W_R, W_G, and W_B in a one-to-one correspondence with the channels.).

[0024] Example adjustment achieved by using the above-described configuration is shown in (1) of Fig. 6. In that case, W_R, W_G, and W_B are the same as one another and G-ch of the signals R, G, and B becomes the maximum-output channel.

[0025] STEP 3 (Adjustment of Circuit gain)

Next, the circuit gain is adjusted in the above-described manner so that the maximum values of the other two channels become substantially equal to $K \cdot W_{RGB}$ (The gains of the channels are determined to be A_R, A_G, and A_B.).

[0026] Thus, the maximum values of the channels of the signals R, G, and B become substantially equal to $K \cdot W_{RGB}$. The above-described state is shown in (2) of Fig. 6 (W_{RGB} indicates any one of W_R, W_G, and W_B in a one-to-one correspondence with the

channels.).

[0027] STEP 4. W_R, W_G, W_B, L_V, A_R, A_G, and A_B obtained by the above-described adjustment process are stored in the memory of the CPU 116 so that they can be used when subsequent image data is acquired.

[0028] Further, W_R, W_G, W_B may not be stored in the memory. However, since the bar-coded white board 103 may be replaced with a different white board, W_R, W_G, and W_B should be stored, so as to confirm whether or not the bar-coded white board 103 was replaced.

[0029] Next, the necessity of constant K used for calculating a target adjustment value at STEP 2 will be described.

[0030] When generating the shading-correction data, first, the values of the above-described L_V, A_R, A_G, and A_B are set to the lamp-lighting voltage and the circuit gain, respectively, and data on the white board 103 is read, and the data is A/D-converted by the CCD 111. The A/D-converted data corresponding to a single line is temporarily stored in the shading-correction-data memories 115, 215, and 315 on a color basis. After that, the data is sequentially read by the CPU 116 by color and converted into shading-correction data, so as to be shading-corrected to the W_{RGB} value for each pixel. Then, the shading-correction data is written back into the shading-correction-data memories 115, 215, and 315. When shading correction is performed at the time where a document is read, A/D-converted document-image data and data on the addresses corresponding to the shading-correction-data memories 115, 215, and 315 are subjected to predetermined calculation by the shading-correction circuits 114, 214, and 314.

[0031] Usually, the shading correction is achieved by a multiplication performed according to Equation (3).

[0032] $DS_j = \alpha j(AD_j - DK_j)$ ··· Equation (3)

· DS_j: image data subjected to shading correction

· AD_j: image data that is not yet subjected to shading correction (A/D output)

· DK_j: dark-time-image data by A/D output

· α_j: shading-correction coefficient

· j: pixel address

Therefore, shading-correction coefficient α_j can be obtained according to Equation (4).

[0033]

[Expression 2]

$$\alpha_i = \frac{W_{RGB}}{(WAD_j - DK_j)} \quad \cdots \text{Equation (4)}$$

· W_{RGB}: W_R or W_G or W_B corresponding to channel

· WAD_j: white-board read value (A/D output)

· DK_j: dark-time read value (A/D output)

[0034] In reality, however, since the shading-correction-data memories 115, 215, and 315 include a limited number of bits, correction areas of the shading correction circuits 114, 214, and 314 are limited. For example, each of the shading correction circuits 114, 214, and 314 has a one to two times correction area.

[0035] Therefore, when the shading-correction circuits 114, 214, and 314 are limited to one to two times correction due to the hardware configuration, the K value should be less than one (e.g., 0.9). If the K value is not less than one, an area in which normal shading correction is not performed is generated. The constant K is provided for solving the above-described problem.

[0036] Namely, each of the maximum values of the channels RGB becomes the value of $K \cdot W_{RGB}$ due to the lamp-lighting-voltage adjustment and the circuit-gain adjustment. Next, each of the maximum values of the channels RGB is corrected, so as to be the value of the entire pixels W_{RGB} by shading correction (when the white board is read).

[0037] When the lamp-lighting voltage and the circuit gain are adjusted according to the adjustment flowchart shown in Fig. 4, the maximum value of each channel is used. However, for decreasing the effect of noises in the line CCD 111 and the circuit system,

1. the maximum value obtained after each of the channels is processed by an LPF is also used. The LPF processing may be performed after an analog circuit system and/or A/D.
2. The maximum value of time average of each channel is used.
3. The combination of the above-described technologies corresponding to 1 and 2.

[0038] That is to say, any one of three values greater than the maximum value of the time average obtained after the channels are processed by the LPF.

[0039] (Other Embodiments) Fig. 7 shows a second embodiment of the present invention.

[0040] In Fig. 7, reference numeral 702 denotes document-platen glass, reference numeral 703 denotes a glass board with a bar-coded white board placed thereon, reference numeral 2 denotes an automatic document feeder placed on the document platen, and reference numeral 704 denotes a jump stage configured to automatically eject a document.

[0041] Reference numeral 55 denotes a CPU configured to control the automatic document feeder. The CPU 55 communicates with the CPU 116 so that they can detect each other and synchronize the time where operations are started, for example.

[0042] The second embodiment is different from the above-described embodiment in that the bar-coded white board is placed on the glass board 703 separated from the document-platen glass 702. Subsequently, the jump stage configured to automatically eject a document can be provided between the glass board 703 and the document-platen glass 702.

[0043] Hereinafter, the necessity of the jump stage 703 will be described.

[0044] The automatic-document feeder 2 shown in Fig. 7 is configured to automatically feed a document to the document-platen glass 702 and eject the document. In Fig. 7, a carrier belt 20 that is wound around a drive roller 17 and a driven roller 19 and that is capable of normal and reverse rotation is provided on the document-platen glass 702.

[0045] A plurality of documents (sheets) 701 is placed on a document platform 5 and a width direction is regulated by a pair of width-regulation boards that are not shown.

[0046] A recycle lever 10 provided on the documents 701 is configured to differentiate between a document for which paper is not yet fed and a document that had been read and copied and that will be ejected onto the document platform 5.

[0047] Reference numeral 9 denotes a semicircle send-out roller configured to rotate at the time of paper feeding so that the documents are sent out from the bottom thereof one by one. Reference numeral 12 denotes a separation belt configured to rotate in a document-return direction and reference numeral 11 denotes a carrier roller. The above-described send-out roller 9, carrier roller 11, and separation belt 12 operate so that the documents are carried one by one.

[0048] Then, the document carried from the document platform 5 by a large roller 13 and a feed roller 15 is fed onto the document-platen glass 702, and carried to a predetermined position by the rotation of the above-described carrier belt 20, whereby the feeding is stopped. The above-described feeding is performed along arrow a.

[0049] The read document is ejected along arrow b by reverse rotation of the carrier belt 20 and rotation of the large roller 13. At that time, however, the read document needs to be lifted in an upward direction from the height position of an upper surface of the document-platen glass 702.

[0050] The above-described jump stage 704 is required for the above-described document lifting.

[0051] Further, the jump stage 704 needs to be provided at a position slightly lower than the upper surface of the document-platen glass 702, so as to achieve the above-described object. Therefore, as described above, the glass on which the bar-coded white board is placed needs to be separated from the document-platen glass 702.

[0052] Fig. 8 shows how the glass board 703 on which the bar-coded white board is placed and the document-platen glass 702 are provided. Reference numeral 903 denotes a white-painted aluminum board and reference numeral 902 denotes a bar-code label. The bar-code label 902 is placed on the aluminum board 903, and the aluminum board 903 is placed on the glass board 901.

[0053] In the above-described embodiment shown in Fig. 7, the methods of performing the lamp-lighting-voltage adjustment, the circuit-gain adjustment, and the shading correction are substantially the same as those shown in Fig. 1 except a single configuration.

[0054] When the automatic document feeder is mounted, as shown in Fig. 7, the document-platen glass 702 includes EC (electro conductive) coated ordinary glass. That is to say, the glass surface of the document-platen glass 702 is made conductive, so as to reduce a trouble relating to the document transfer, the trouble being caused by static electricity that occurs due to the friction between the document-platen glass 702, a document, and the carrier belt 20. The transmittance of the EC-coated glass is slightly lower than that of ordinary glass. Subsequently, the level of each of the signals R, G, and

B obtained when a document is read by using the EC-coated glass becomes lower than that in the case where the document is read by using ordinary glass by as much as four to six %.

[0055] Subsequently, shading-correction coefficient α_j needs to be calculated by using the following Equation (5), which is the modification of the above-described Equation (4).

[0056]

[Expression 3]

$$\alpha_j = \frac{W_{RGB}}{(WAD_j - DK_j)} \times \frac{1}{\beta_{EC}} \quad \cdots \text{Equation (5)}$$

· β_{EC}: the signal-level decrease rate obtained when the glass is EC coated

[0057] Therefore, when the automatic document feeder is provided, the shading-correction coefficient is calculated according to Equation (5). As a result, a suitable signal level can be obtained when a document is read.

[0058] Further, if the document-platen glass 702 is EC coated in the case where a document is read without using the automatic document feeder 2 shown in Fig. 7, as shown in Fig. 9, the shading-correction coefficient needs to be calculated according to Equation (5).

[0059] According to the above-described method for calculating shading-correction coefficient α_j, the shading-correction coefficient should be calculated, as shown below.

[0060]

[Table 1]

Table 1

	EC-coated glass	Ordinary glass
RDF mounted	Equation (5)	Impossible since RDF does not operate normally
RDF non-mounted	Equation (5)	Equation (4)

(RDF: automatic document feeder)

[0061] That is to say, when the CPU 116 detects that the automatic document feeder is mounted through the communications with the CPU 55, or when the CPU 116 detects the setting state of the EC-coated document-platen glass by using backup data (set to a backup memory (not shown) of the CPU 116 when shipped from factory) showing whether or not the EC-coated document-platen glass is mounted, the CPU 116 calculates the shading-correction coefficient according to Equation (5). Otherwise, the CPU 116 calculates the shading-correction coefficient according to Equation (4).

[0062] Subsequently, even though the feeder including no EC-coated document-platen glass is sold, and the automatic document feeder is mounted thereon (naturally, the document-platen glass is replaced with EC-coated document-platen glass), the shading correction calculation can be performed without an error.

[0063] Further, Fig. 10 shows an example screen used for determining whether or not the EC-coated document-platen glass should be mounted.

[0064] Fig. 10 shows an example screen of the operation-display unit 140 including a touch panel. Settings on whether or not the document platen glass should be EC coated are made by reading and displaying the above-described screen in service mode or the like.

[0065] Where a user arbitrarily changes the above-described settings, the level of a read-image signal becomes incorrect. Therefore, it may be configured that the user cannot arbitrarily change the settings.

[0066]

[Table 2]

(base thirty-six numbers → base ten numbers conversion)

Table 2

base thirty-six numbers	base ten numbers	base thirty-six numbers	base ten numbers
0	0	I	18
1	1	J	19
2	2	K	20
3	3	L	21
4	4	M	22
5	5	N	23
6	6	O	24
7	7	P	25
8	8	Q	26
9	9	R	27
A	10	S	28
B	11	T	29
C	12	U	30
D	13	V	31
E	14	W	32
F	15	X	33
G	16	Y	34
H	17	Z	35

[0067]

[Advantages] Thus, according to the present invention, the lamp-light-amount adjustment and the read-signal-level adjustment are performed according to the white-board chromaticity recorded on the bar code. Therefore, a signal can be read without being affected by variations in the density of a white board and/or white paper, which was previously impossible.

[0068] Further, a reference white board is separated from document-platen glass, and the type of the document-platen glass can be set. Therefore, even though an automatic document-feed mechanism is used, the lamp-light-amount adjustment and the read-signal-level adjustment can be performed excellently.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 shows an example configuration of an image reader according to the present invention.

[Fig. 2] Fig. 2 shows the configurations of a bar-coded white board and document-platen glass.

[Fig. 3] Fig. 3 is an external view of the bar-coded white board.

[Fig. 4] Fig. 4 shows the details on the bar code.

[Fig. 5] Fig. 5 is a flowchart illustrating procedures of adjusting a lamp-lighting voltage and a circuit gain.

[Fig. 6] Fig. 6 shows the status of adjustment operations.

[Fig. 7] Fig. 7 shows an example configuration of an image reader with an automatic document feeder.

[Fig. 8] Fig. 8 shows the configuration of a bar-coded white board and document-platen glass.

[Fig. 9] Fig. 9 shows an example configuration of a document reader.

[Fig. 10] Fig. 10 shows an example display on a setting screen.

[Reference Numerals]

2: automatic document feeder

104: light source

111: line CCD

112: analog-signal-processing circuit

702: document-platen glass

703: glass board

[Fig. 1]

114: SHADING-CORRECTION CIRCUIT OUTPUT R

115: SHADING-CORRECTION-DATA MEMORY

214: SHADING-CORRECTION CIRCUIT OUTPUT G

216: SHADING-CORRECTION-DATA MEMORY

314: SHADING-CORRECTION CIRCUIT OUTPUT B

315: SHADING-CORRECTION-DATA MEMORY

140: OPERATION-AND-DISPLAY MEANS

[Fig. 2]

SCAN DIRECTION

[Fig. 4]

PARITY

BAR-CODE DATA (BASE THIRTY-SIX NUMBERS → DECIMAL NUMBERS)

CONVERT INTO RGB VALUES

[Fig. 5]

START

STEP 1: READ DENSITY DATA (CONVERTED INTO RGB VALUES) RECORDED ONTO WHITE BOARD → W_R, W_G, W_B

STEP 2: SET CIRCUIT GAIN FROM CCD TO A/D TO default VALUE, READ WHITE BOARD, AND ADJUST LAMP-LIGHTING VOLTAGE SO THAT THE CURRENT MAXIMUM OUTPUT Q (THAT HAD BEEN SUBJECTED TO A/D PROCESSING) OF EACH OF CHANNELS R, G, AND B IS REPRESENTED BY:

$Q \approx K \cdot W_{RGB}$ (WHERE K DENOTES CONSTANT)

$\rightarrow L_V$

STEP 3: ADJUST CIRCUIT GAIN SO THAT OUTPUTS (THAT HAD BEEN SUBJECTED TO A/D PROCESSING) OF LEFT TWO CHANNELS OF CHANNELS R, G, AND B BECOME EQUAL TO $K \cdot W_{RGB}$

$\rightarrow A_R, A_G, A_B$

STEP 4: STORE VALUES OF W_{RGB}, L_V, A_R, A_G, AND A_B IN MEMORY

END

[Fig. 6]

(1) LAMP-LIGHTING-VOLTAGE ADJUSTMENT

(2) CIRCUIT-GAIN ADJUSTMENT

GAIN UP R

GAIN UP B

(3) SHADING CORRECTION

ENTIRE PIXELS OF R, G, AND B BECOME EQUAL TO W

[Fig. 7]

114: SHADING-CORRECTION CIRCUIT OUTPUT R

115: SHADING-CORRECTION-DATA MEMORY

214: SHADING-CORRECTION CIRCUIT OUTPUT G

215: SHADING-CORRECTION-DATA MEMORY

314: SHADING-CORRECTION CIRCUIT OUTPUT B

315: SHADING-CORRECTION-DATA MEMORY

140: OPERATION-AND-DISPLAY MEANS

[Fig. 9]

114:	SHADING-CORRECTION CIRCUIT	OUTPUT R
115:	SHADING-CORRECTION-DATA MEMORY	
214:	SHADING-CORRECTION CIRCUIT	OUTPUT G
215:	SHADING-CORRECTION-DATA MEMORY	
314:	SHADING-CORRECTION CIRCUIT	OUTPUT B
315:	SHADING-CORRECTION-DATA MEMORY	
140:	OPERATION-AND-DISPLAY MEANS	

[Fig. 10]

[DOCUMENT-PLATEN-GLASS TYPE]

1. EC-COATED
   (RDF GLASS)
2. NON-COATED
   (NORMAL GLASS)

SET

(TOUCH PANEL)